16 March 1979
[redacted]
Square Radome
Structural Engineering
Handbook
p 19-16 thru 19-17

WINDLOADING REQUIREMENTS

1. The windload from 150 mph wind is computed as follows:

$$\begin{aligned} psf &= .00256V^2 \qquad V = mph \\ &= .00256(150)^2 \\ &= 57.6 \text{ psf} \end{aligned}$$

2. The windload on the shed with 2 panels removed and a 40 mph wind. The positive pressure is assumed to be at full load while the negative pressure, due to a "vacuum" on the leeward side is 0.40.

$$\begin{aligned} psf &= .00256V^2 \text{ (positive factor + negative factor)} \\ &= .00256(40)^2(1.00 + 0.40) \\ &= (.00256)(1600)(1.4) \\ &= 5.7344 \text{ psf} \end{aligned}$$

3. A 60 mph wind with 30 psf load from snow or ice

$$\begin{aligned} psf &= (.00256)(V^2) + 30 \\ &= (.00256)(3600) + 30 \\ &= 9.216 + 30 \\ &= 39.216 \text{ psf} \end{aligned}$$

4. The requirement to resist 70 psf with no wind appears to be the worst case for the roof. If this load is ice, the ice would have to be

$$\frac{(70)(12)}{(62.4)(.88)} = 15 \text{ inches thick}$$

If the load is snow, the depth would be

$$\frac{(70)(12)}{(62.4)(.125)} = 107.7 \text{ inches or about 9 feet deep}$$

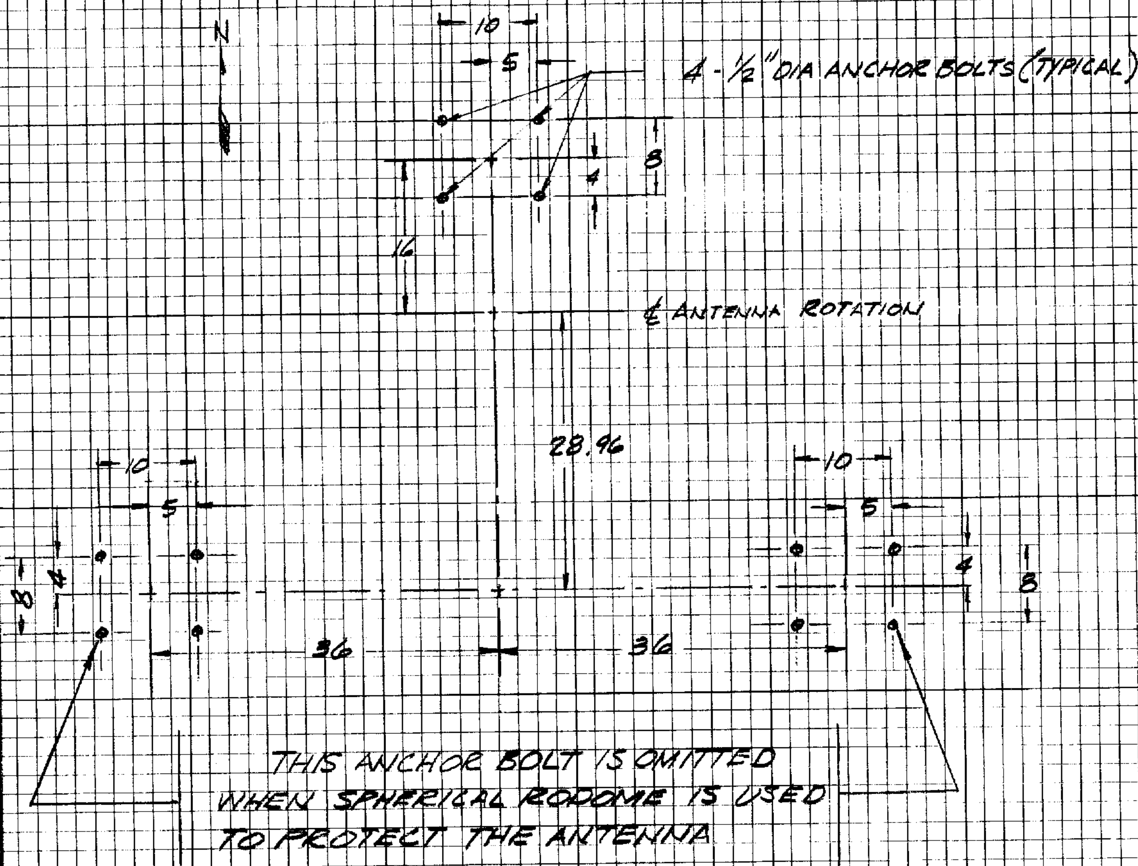
REF. OCE - M78 - 535

DESIGN AN ADAPTER SO THAT EXISTING FOUNDATION BOLTS CAN BE USED WITH A NEWER MODEL ANTENNA

FURNISHED ARE
- OLD ANTENNA BOLT LAYOUT
- NEW ANTENNA BOLT LAYOUT
- CLEARANCES OF NEW ANTENNA IN TWO STYLES OF RADOME
- CALCULATED WIND LOADS ON NEW ANTENNA.

FURNISH PLANS AND SPECIFICATIONS TO CONSTRUCT ADAPTER

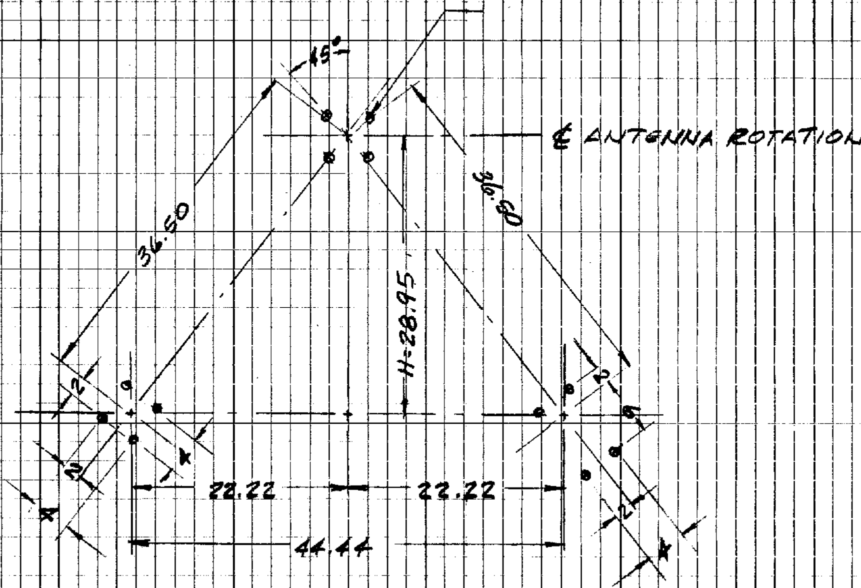
EXISTING ANTENNA BOLT LAYOUT



SCALE: 1" = 20"

FEB/RECD	ANTENNA ADAPTER / COMMO	JAN 16 1979	L.L.C.	2/9

NEW ANTENNA BOLT LAYOUT



$$H = \sqrt{(36.50)^2 - (22.22)^2}$$
$$= \sqrt{1332.25 - 493.73}$$
$$= \sqrt{838.52}$$
$$= 28.95''$$

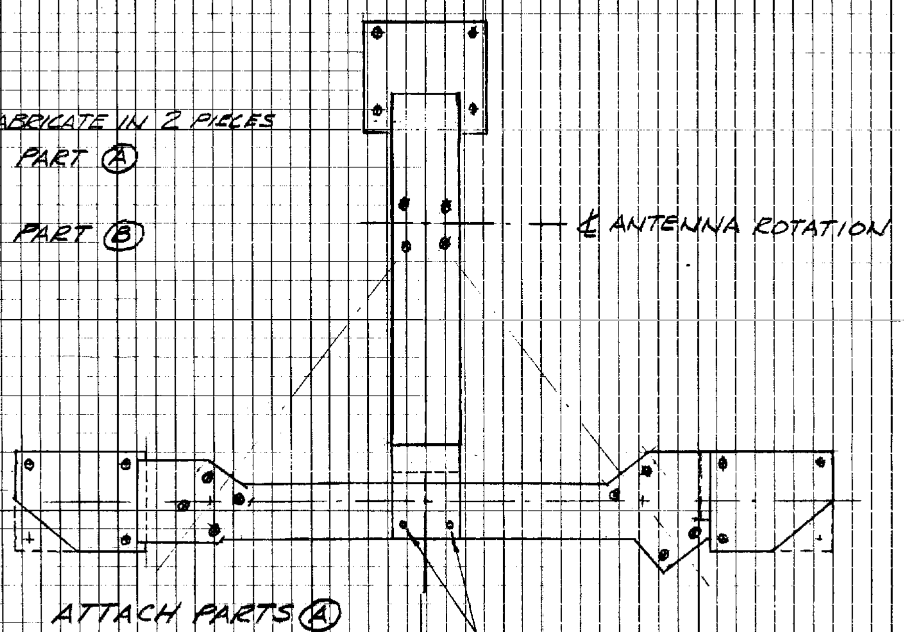
SCALE: 1" = 20"

ANTENNA ADAPTER BOLT LAYOUT COMBINING OLD AND NEW REQ'M'TS

FABRICATE IN 2 PIECES

PART (A)

PART (B)



ATTACH PARTS (A)
AND (B) AT THIS POINT
WITH 2 - ½" DIA BOLTS

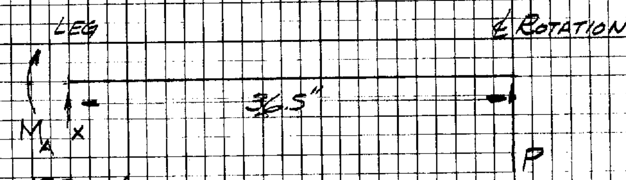
SCALE: 1" = 20"

LOAD CALCULATIONS

THE WEIGHT OF THE ANTENNA IS CONCENTRATED DOWNWARD AT THE CENTER OF THE POINT OF ROTATION. OF A TOTAL WEIGHT OF 800 POUNDS, ASSUME 700 POUNDS ACTS ON THE ADAPTER AT THIS POINT UNDER A "NO WIND" CONDITION.

FROM PREVIOUS CALCULATIONS FOR WIND LOADS
150mph yelds 5405 lbs/ft of moment
100mph yelds 2400 lbs/ft. of moment

USING THE MOMENT ARM OF INCHES, THE FOLLOWING ADDITIONAL FORCE WOULD BE ADDED TO THE ADAPTER PART (A) AT THE POINT OF ROTATION.



150mph

$\Sigma M_x = 0$

$5405 = \frac{36.5}{12} P_{150}$

$P_{150} = \frac{(5405)(12)}{36.5}$

$P_{150} = 1777$ lbs.

100mph

$\Sigma M_x = 0$

$2400 = \frac{36.5}{12} P_{100}$

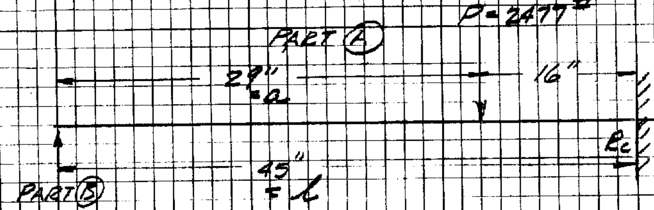
$P_{100} = \frac{(12)(2400)}{36.5}$

$P_{100} = 789$ lbs

TOTAL FORCE AT P

1777	789
700	700
2477	1489

FOR PART (A) ASSUME THAT THE END ATTACHED TO PART (B) IS FREE TO ROTATE WHILE THE END ATTACHED TO THE OLD FOUNDATION BY 4 EXISTING BOLTS IS FIXED OR MOMENT RESISTANT.



$R_B = \frac{2477(16)^2}{(2)(45)^3}(29+90)$

$= 414\#$

$R_C = \frac{(2477)(29)}{(2)(45)^3}(3(45)^2 - 29^2$

$= 2062\#$

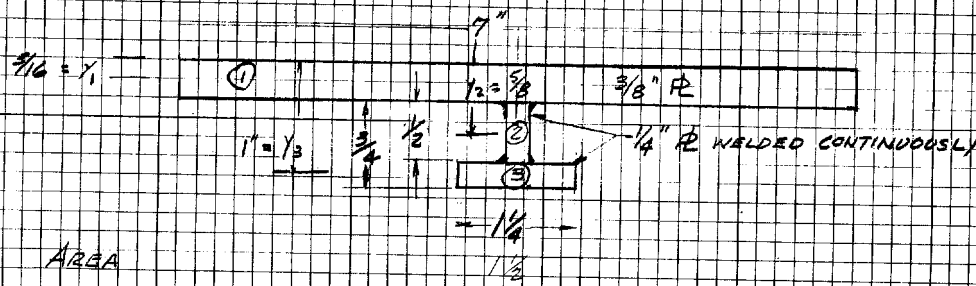
THE MAXIMUN DEFLECTION, Δ_{max}, IS THE REPRESENTED BY

$$\Delta_{max} = \frac{Pa(l^2-a^2)^3}{3EI(3l^2-a^2)^2}$$

AND $E = 30 \times 10^6$ FOR STEEL

I = MOMENT OF INERTIA OF SECTION

FROM ADAPTER SKETCH ON PAGE 2, PART (A) IS APPROXIMATELY 7" WIDE AT THE AREA WHERE BENDING WILL OCCUR. USE THE FOLLOWING STIFFENED SECTION.



AREA

$$A = A_{①} + A_{②} + A_{③}$$
$$= (7)(3/8) + (1/2)(1/4) + (1\tfrac{1}{4})(1/4)$$
$$= 2.625 + 0.125 + 0.3125$$
$$= 3.0625 \text{ in}^2$$

CENTROID $- \bar{Y}$

$$\Sigma A\bar{Y} = A_1 Y_1 + A_2 Y_2 + A_3 Y_3$$
$$3.0625\bar{Y} = (2.625)(0.1875) + (0.125)(0.625) + (0.3125)(1.00)$$
$$3.0625\bar{Y} = 0.4922 + 0.0781 + 0.3125$$
$$\bar{Y} = \frac{0.8828}{3.0625}$$
$$\bar{Y} = 0.2883''$$

MOMENT OF INERTIA $- \bar{I}$

$$\bar{I} = I_1 + A_1(\bar{Y}-Y_1)^2 + I_2 + A_2(\bar{Y}-Y_2)^2 + I_3 + A_3(\bar{Y}-Y_3)^2$$
$$= \tfrac{1}{12}(7)(\tfrac{3}{8})^3 + 2.625(0.2883-0.1875)^2 + \tfrac{1}{12}(\tfrac{1}{4})(\tfrac{1}{2})^3 + 0.125(0.625-0.2883)^2$$
$$+ \tfrac{1}{12}(1\tfrac{1}{4})(\tfrac{1}{4})^3 + 0.3125(1.000-0.2883)^2$$
$$= (.5833)(.0527) + 2.625(.0102) + .0026 + 0.125(.1134)$$
$$+ .1042(.0313) + 0.3125(.5065)$$
$$= .0307 + .0268 + .0026 + .0142 + .0033 + .1583$$
$$= .2359$$

OPTION 2 INCREASE WIDTH OF BOTTOM MEMBER FROM $1\frac{1}{4}$" TO $1\frac{1}{2}$"

AREA

$$A = A_1 + A_2 + A_3$$

$$A = 2.625 + 0.125 + 0.375$$

$$A = 3.125$$

CENTROID $- \bar{y}$

$$\Sigma A \bar{y} = A_1 y_1 + A_2 y_2 + A_3 y_3$$

$$3.125 \bar{y} = 0.4922 + 0.0781 + 0.375$$

$$\bar{y} = \frac{0.9453}{3.125}$$

$$\bar{y} = 0.302$$

MOMENT OF INERTIA $- \bar{I}$

$$I = I_1 + A_1(\bar{y} - y_1)^2 + I_2 + A_2(y_2 - \bar{y})^2 + I_3 + A_3(y_3 - \bar{y})^2$$

$$= .0307 + .0344 + .0026 + .0130 + .0039 + .1827$$

$$= .2673$$

DEFLECTIONS $- \Delta$

$$\Delta = \frac{Pa(l^2 - a^2)^3}{3EI(3l^2 - a^2)^2}$$

$$= \frac{P}{I}\left[\frac{a(l^2 - a^2)^3}{3E(3l^2 - a^2)^2}\right]$$

$$= \frac{P}{I}\left[\frac{29(45^2 - 29^2)^3}{(3)(30)(10^6)[(3)(45^2) - 29^2]^2}\right]$$

$$= \frac{P}{I}\left[\frac{29(1184)^3}{(3)(30)(10^6)(5234)^2}\right]$$

$$= \frac{P}{I}\left[\frac{(29)(1.6598)(10^9)}{(3)(30)(10^6)(2.739)(10^7)}\right]$$

$$= \frac{P}{I}\ .00001953$$

$$\Delta_{150} = \frac{(2477)}{.2359}(.00001953) = .205 \text{ in}$$

$$\Delta_{150\ option} = \frac{2477}{.2673}(.00001953)$$

$$= .181\ in$$

$$\Delta_{100} = \frac{1489}{.2359}(.00001953)$$

$$= .123$$

$$\Delta_{100\ option} = \frac{1489}{.2673}(.00001953)$$

$$= .109\ in$$

STRESS IN SECTION AT CONNECTION TO EXISTING NORTH ANCHORS

$$M = \frac{f I}{c}$$

$$f = \frac{Mc}{I}$$

$$M_{\text{¢ Rotation}} = 414\left(\frac{29}{12}\right)$$

$$= 1000\ ft^{\#}$$

$$M_{Fixed} = \frac{(2477)\left(\frac{29}{12}\right)\left(\frac{16}{12}\right)}{2\left(\frac{45}{12}\right)^2}\left(\frac{29}{12} + \frac{45}{12}\right)$$

$$= \frac{(2477)(2.417)(1.333)}{(2)(14.062)}(6.167)$$

$$= 1749.97\ ft^{\#}$$ [1051 ft.# for 100 mph]

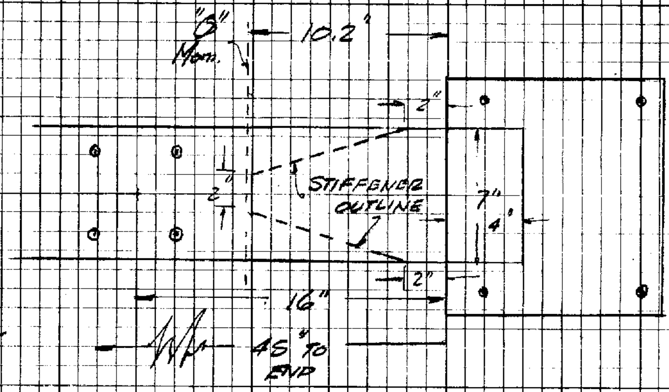
$$f = \frac{(1749.97)(12)(1.125 - .302)}{.2673}$$

$$= (1749.97)(12)(0.823)$$

$$= 64620\ psi$$

Since the upper limit of the most readily available steel, A-36, is 36,000 psi yield, the adapter must be striffened at this point to insure no inelastic deformation during 150 mph wind condition.

STIFFENER FOR PART (A) AT CONNECTION TO EXISTING ANCHOR BOLTS



POINT OF 0 MOMENT

$= \frac{Pa}{R_2}$

$= \frac{(2477)(29")}{2062}$

$= 34.8"$ from R_2 ∴ $45" - 34.8 = \underline{10.2"}$

ASSUME STIFFENER TO BE 1/2" THICK EXTENSION OF SPACER BETWEEN THE THE PLATES. THE EFFECTIVE CROSS SECTION WOULD THEN BE 7" WIDE AND 7/8" THICK

$I = \frac{1}{12} bh^3$

$= (\frac{1}{12})(7)(\frac{7}{8})^3$

$= 0.391$

$f = \frac{Mc}{I}$

$= \frac{(1749)(12)(\frac{7}{16})}{.391}$

$= 23,484$ psi WHICH IS WITHIN THE 36,000 psi limit

WOULD STIFFENER BE REQUIRED UNDER 100 mph CONDITIONS

$f = \frac{Mc}{I}$

$= \frac{(1000)(12)(.823)}{.2673}$

$= 36,947$ psi WHICH IS VERY CLOSE TO 36,000 psi limit.

∴ STIFFENER NOT REQUIRED.

ESTIMATED WT.

PART (A)

9/8" PL

(12)(7) = 84

(40)(7) = 280

(12)(13) = 156

520 □"

$\frac{520}{144}$ = 3.61 □' @ 15.3 #/ft² = 55.23

1/2" PL

(6)(7) = 42

(2½)(8) = 20

(2)(8) = 16

78

$\frac{78}{144}$ = .54 □' @ 20.4 #/ft² = 11.02

1/4" PL

(1¼ + ½)(35) = 61.25

$\frac{61.2}{144}$ = .425 □' @ 10.2 #/ft² = 4.34

70.6 #

PART (B)

3/8" PL

(14)(10½)(2) = 294

−(5)(7) = −35

(38)(6) = 228

(2½)(6) = 15

(6)(11) = 66

(5)(8/2) = 20

(7)(9/2) = 31.5

(7)(5) = 35

(5)(5/2) = 12.5

667

$\frac{667}{144}$ = 4.63 ft² @ 15.3 #/ft² = 70.84 #

1/2 PL

(2)(7) = 14

(2)(8) = 16

30

$\frac{30}{144}$ = .21 ft² @ 20.4 #/ft² = 4.25

1/4 PL (1¼ + ½)(35) = 61.25 $\frac{61.25}{144}$ = .425 ft² @ 10.2 #/ft² = 4.34

79.43 #

FEB / RECD	ANTENNA ADAPTER / COMMO	JAN 17 1979	C.C.C.	9/9

TOTAL WT.

PART A = 70.6#

PART B = 79.4#

150.0# plus nuts, bolts, washers

Approved For Release 2001/08/09 : CIA-RDP86-00800R000100160002-9